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DR. G. W. IRVING, JR.
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*Washington, D.C.

March 1964

UTILIZATION RESEARCH IN USDA

These are days of unprecedented abundance in American agriculture. We have large surpluses of a few crops, and record quantities of many others are being produced.

This abundance is one of the Nation's most valued resources, but it poses a formidable challenge to our agricultural economy. Utilization research is one approach to meeting this challenge. It is an organized effort through science and technology to increase present uses and to discover and develop varied new uses for farm products.

This research is designed to provide our farmers with new markets and a strengthened demand for their output. It benefits not only farmers, but the Nation as a whole by creating new and better products from agricultural materials.

The U.S. Department of Agriculture has been carrying on what is now known as utilization research for the more than one hundred years of its existence. In 1938, through the Agricultural Adjustment Act, the Congress directed the Secretary of Agriculture to establish four regional laboratories where this work would be coordinated.

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Construction of the laboratories, which were essentially identical in design, was undertaken simultaneously at Peoria, Illinois, New Orleans, Louisiana, Albany, California (near San Francisco), and Wyndmoor, Pennsylvania (near Philadelphia). They were the Northern, Southern, Western, and Eastern Regional Research Laboratories, respectively. As these research organizations grew, field stations were added to them and it was recognized that many of their programs were national rather than regional in scope. Accordingly the Regional Research Laboratories became headquarters of what are now known as Utilization Research and Development Divisions of the Agricultural Research Service.

Most of the scientific work is done in the headquarters and field stations of these Divisions. Some is also performed under contracts or grants with various research institutions. Under the terms of Public Law 480, laboratories abroad receive utilization research grants, payments for which are made in the country's own currency in return for American farm commodities.

In common with other USDA research programs, utilization research is reviewed annually by various commodity and functional advisory committees appointed by the Secretary of Agriculture. These include representatives of the people for whose advantage the research is performed, such as growers, handlers, processors, transportation and storage groups, and consumers, as well as qualified non-Government scientists. These committees periodically review the utilization research effort and make recommendations to help maintain an efficient and realistic program. Through these committees a close liaison is maintained with agricultural experiment stations and industrial institutions engaged in related work.

This administrative framework is designed to focus the utilization research effort on the most important and promising areas, without hampering the initiative of the individual scientists.

Headquarters of the Eastern Utilization Research and Development Division, Wyndmoor, Pa.

UTILIZATION RESEARCH AT THE EASTERN DIVISION

The principal farm commodities of the country are assigned for purposes of utilization research to one of the four Utilization Research and Development Divisions, generally to the one serving the region in which they are primarily grown. The Eastern Division, which covers a 14-State area from Maine to Kentucky, is charged with research on animal products, including dairy, meat, fats, and leather; plant products, including Eastern fruits and vegetables, tobacco, honey, maple, and new crops; and studies on the allergens of agricultural commodities.

On these commodities the Eastern Utilization Research and Development Division conducts a comprehensive program of fundamental and applied research in chemistry, the physical sciences, the biological sciences, and engineering. The Division consists of the following ten Laboratories:

Animal Fat Products Laboratory
Animal Fat Properties Laboratory
Dairy Products Laboratory
Milk Properties Laboratory
Meat Laboratory
Hides and Leather Laboratory

Plant Products Laboratory
Engineering and Development Laboratory
Animal Proteins Pioneering Laboratory
Agricultural Allergens Pioneering Laboratory

All of these Laboratories are located in the Division's headquarters building in Wyndmoor, Pennsylvania, except for the Dairy Products Laboratory (Washington, D.C., and Beltsville, Maryland), the Allergens Laboratory (Washington, D.C.), and the Meat Laboratory (Beltsville and Wyndmoor). In 1964 a new processing laboratory for potato products is expected to be in operation at East Grand Forks, Minnesota, which will be the only activity of the Engineering and Development Laboratory not located at Wyndmoor.

The Eastern Division staff consists of about 400 Civil Service employees, a majority of whom are scientists and technicians. The rest provide administrative management, stenographic and clerical services, operation and maintenance of buildings, and mechanical services.

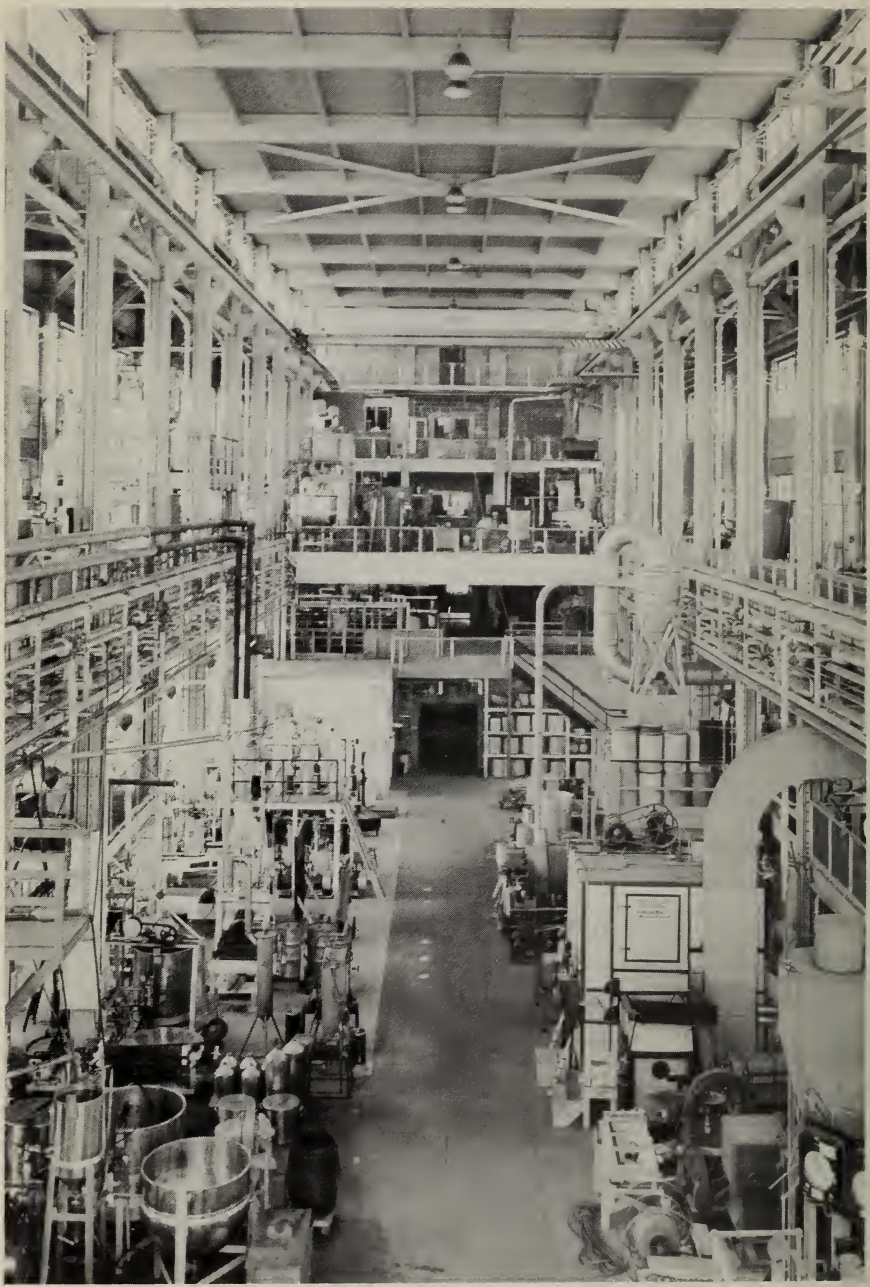
Fields of research in the Eastern Division.

Library at Wyndmoor contains 17,000 volumes and receives 400 scientific and technical periodicals.

PHYSICAL FACILITIES

The U-shaped, three-story headquarters building of the Eastern Division at Wyndmoor houses a series of nearly 100 interconnected laboratory rooms with small adjoining offices for study and writing, a basement-to-roof pilot plant that occupies almost one full wing of the building, administrative offices, library, auditorium, conference rooms, shops, and a cafeteria. Smaller buildings located elsewhere on the grounds are used for large-scale solvent extractions and high-pressure experiments and meat-processing studies.

The Laboratories of the Eastern Division—at Wyndmoor as well as at Washington and Beltsville—are well equipped with modern analytical instruments; for example, nuclear magnetic resonance spectrometer, automatic amino acid analyzers, countercurrent distribution apparatus, mass spectrometer, ultracentrifuges, x-ray scattering and diffraction equipment, spectrophotometers, electron microscope. Special processing equipment for the dehydration of fruits and vegetables and whole milk, and for the removal of radiostrontium from milk, are available in the pilot plants of the Division. Also available are a smokehouse and cold boxes for meat research and special taste-testing facilities.



Pilot plant at Wyndmoor.

Taste panel at work in food preparation and evaluation laboratory, Wyndmoor.

Nuclear magnetic resonance spectrometry permits the structure of organic materials to be studied by observing the behavior of their atomic nuclei in a magnetic field.

THE LABORATORIES

The Eastern Utilization Research and Development Division consists of 7 laboratories for research on specific commodities and groups of commodities, 1 for engineering and development, and 2 for pioneering research.

The commodity Laboratories are doing both fundamental and applied research to widen outlets in their assigned areas through the development of new or improved products and processes. The Engineering and Development Laboratory is responsible for engineering research and pilot-plant development in all commodity areas. At the Pioneering Research Laboratories fundamental research is in progress on animal proteins and on agricultural allergens.

The following is a brief account of the work being done in each of these Laboratories. This, along with the next section, indicates the direction of the work, the kinds of results to be expected, and some of the outstanding accomplishments for which the Eastern Division is already known.

Animal Fat Products Laboratory

DR. W. C. AULT, *Chief*

Inedible animal fats have posed a serious utilization problem ever since synthetic detergents began to replace soap. Rising consumption of meat has further aggravated the situation by increasing the tonnages of these fats to be disposed of. A steady demand for animal fats abroad has prevented an actual accumulation of surpluses, but domestic markets that will be both more reliable and more profitable are urgently needed.

One research approach to wider utilization involves the development of new products through chemical modification of animal fats and their derivatives. Scientists of this Laboratory have established a place for fats in the huge plastics industry with their plasticizers made of epoxidized fatty acids. They have also developed vinyl stearate, a copolymer with permanent flexibility, and plasticizers called dialkylphosphonostearates, which keep plastics soft even at 50° below zero F. Research is continuing on other chemical approaches to the production of fast-based plastics and lubricants.

Excellent detergents made at this Laboratory by the sulfonation of fatty acids and by other means are now under special consideration because the straight-chain structure of fats should make them much more biodegradable than the most widely used petroleum-based detergents. (See page 22.)

Animal Fat Properties Laboratory

DR. L. P. WITNAUER, *Chief*

Basic to the development of new products from animal fats—or any other raw material, for that matter—is a full understanding of fundamental properties. In this Laboratory the most advanced methods and facilities are used to determine the chemical composition and structure and physical properties of fats. They are also used to evaluate products made from fats.

Among the techniques used for these analyses are gas-liquid chromatography, nuclear magnetic resonance, x-ray diffraction, and electron microscopy.

Gas-liquid chromatography is a widely used analytical method for fat compounds.

Work is done on meat fats as well as on inedible fats. Also performed in this Laboratory is some research on the epoxy fatty acids of oils from uncultivated plants that might be industrially useful. The excellent equipment available in this Laboratory is also used for fundamental studies on substances other than fats which are of interest to other Laboratories of the Eastern Division, such as the protein collagen which is found in hides.

Dairy Products Laboratory

DR. B. H. WEBB, *Chief*

Utilization research on milk and milk products forms a large and important part of the Eastern Division's program. Research on concentrated and dried milk, cheese, and butter aims at improving quality and lowering costs through better methods of processing, handling, and preserving. Scientists are trying to identify the specific flavor components of milk for a better understanding of the reasons for taste changes and off-flavor development during the processing and storage of milk and milk products. In other research, cheese-making procedures are being mechanized, failures in bacterial starter cultures for cheese are being overcome, (see page 30), and profitable uses for byproduct whey are being sought.

Contract research is being done to improve the keeping properties of butter and butter oil and also to adapt the new continuous fermentation process for breadmaking to the use of formulas containing high levels of nonfat milk solids.

A foam-spray-drying process, developed at the Dairy Products Laboratory and used successfully to dry cottage cheese whey and skim milk, is currently being used experimentally to make dry whole milk. (See page 24.)

New and improved methods of cheese production are under investigation at Beltsville, Md. laboratory.

A method of removing strontium 90 from milk, which was developed on a pilot-plant scale at the Dairy Products Laboratory in Beltsville, is now being adapted to full-scale operation at a commercial dairy. (See page 27.)

Milk Properties Laboratory

DR. G. C. NUTTING, *Chief*

Milk is a highly complex substance, and fundamental studies of its composition and physical behavior are needed to support inventive dairy-products research. The work of this Laboratory is largely limited to the proteins of milk, since these are the least known milk components. Physical chemists are using ultracentrifugal, electrophoretic, light-scattering, and radioactive-tracer techniques to determine the molecular-kinetic properties of milk proteins in solution and to measure the forces acting between the proteins and other molecules.

These studies have revealed subtle differences in milk caseins (thought to be homogeneous by scientists only a generation ago) and peculiarities in the molecular behavior of the whey protein beta-lactoglobulin. Beyond their significance to dairy processing, these findings may yield clues of far-reaching importance in the field of genetics. (See page 28.)

Biochemists of this Laboratory are studying milk enzymes, the effect of heat on milk proteins, and interactions among the various components of milk. One of the ultimate objectives of this biochemical research is to make concentrated milks better able to resist fat separation and gelation on storage.

Starch-gel electrophoresis analysis reveals subtle differences in milk casein components.

Hides and Leather Laboratory

DR. J. NAGHSKI, *Chief*

A sharp decline in the demand for leather has emphasized the need for more economical and better leathers to meet the competition of plastics and other substitutes. The research at this Laboratory is seeking to hold and expand the market that leather still commands, and to open up new large-scale outlets for leather, for example, in the garment field.

New leathermaking processes are tried out in experimental tannery.

Leathers with perspiration resistance and other unique properties are now being produced commercially by a glutaraldehyde tanning process developed in this Laboratory. (See page 25.) Another chemical whose value as a tanning agent has been demonstrated by this research is dialdehyde starch, which can be made economically from corn by a process developed at the

Northern Utilization Research and Development Division.

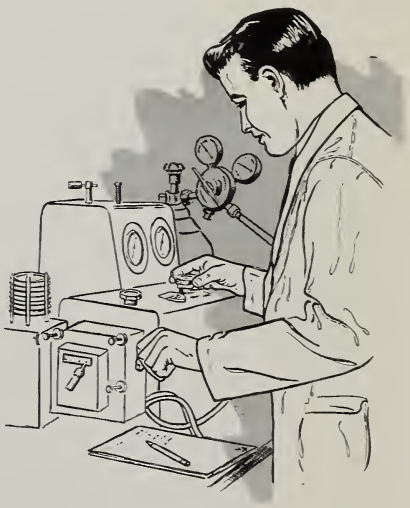
A rapid method of unhairing hides by the use of enzymes, now under development, may introduce new economy and efficiency in leather production.

Balancing these practical investigations, and providing background information for them, is a fundamental study of the physical structure and basic chemical components of hides and leather.

Meat Laboratory

W. L. SULZBACHER, *Chief*

Research in this Laboratory is designed to improve methods of handling, preserving, and processing meats. Better quality in meat and meat products is being sought through chemical, biological, and technological investigations. A basic study of meat proteins and their interactions with the nonprotein components of meat, such as fat and minerals, is in progress. The work is establishing the relationship of these components to meat structure and to such properties as juiciness, tenderness, and flavor.



Research with flame photometer determin the minerals in meat.

Studies in this Laboratory by gas chromatography and other sophisticated techniques is establishing the specific flavor components of various meats.

With the ultimate objective of improving the keeping properties of meat and meat products, the biochemical changes occurring during the processing and freezer-storage of meats are traced and related to flavor changes. Means of retarding rancidity are sought through a basic study of the chemical nature of this phenomenon. The effect of enzymes on the stability of meat and meat products is also under study in this Laboratory.

Microbiologists at the Meat Laboratory are studying microorganisms that might have a beneficial effect on meats as well as those which are undesirable. For example, bacteria are studied in relation to improved flavor in cured meat products. On the other hand, research is done on microorganisms that grow at low temperatures and limit the storage life of frozen meats.

The Meat Laboratory's program of fundamental research on problems related to meat processing and distribution is balanced by an active program of technological research leading to the development of new meat products.

Plant Products Laboratory

DR. C. F. WOODWARD, *Chief*

A wide variety of products is being studied in this Laboratory, including Eastern fruits and vegetables, honey, maple sap and sirup, tobacco, and special plants. Much basic research is being done on these materials—for example, studies of the chemical composition and physical structure of fruits

Cigarettes are puffed on mechanically in this machine and their smoke is trapped for subsequent chromatographic analysis.

and vegetables—which are designed to show how the flavor, appearance, and nutritional value of fresh farm products can better be preserved in processing.

Fundamental research on the bruising of cherries and its effect on the respiration of this fruit has contributed importantly to the development of mechanical harvesting equipment. (See page 30.)

Most of the Eastern Division's research program on vegetables is concentrated on potatoes. Separation and identification of the amino acids of potatoes is providing fundamental information on this important food which is of value to processors and nutritionists alike.

Chromatographic analysis of various types and grades of tobacco leaf and of cigar and cigarette smoke is establishing the relationship between the chemical components of tobacco and the quality of tobacco products.

Research on honey has found new uses for this important sweetener—for example, as an ingredient for pharmaceutical preparations and baked goods. More recent analyses of honey samples collected from all over the country, using the most advanced analytical techniques, have permitted a precise characterization of honeys of different floral types.

Research in this Laboratory on maple sap and sirup has vastly improved both the quantity and quality of sap being produced and increased the value of sirup and other products made from it. Maple sugaring is being transformed from a small part-time farm operation to a profitable year-round business, thanks to the more efficient methods and improved equipment developed as a result of this work. (See page 26.)

Special investigations of the Plant Products Laboratory consist of a screening of Dioscorea plants for steroidal sapogenins from which hormone drugs can be made; a determination of spice constituents; and a study of the enzyme inhibitors in grape leaves which have been discovered to control the softening of brined cucumbers in the commercial processing of pickles.

Engineering and Development Laboratory

R. K. ESKEW, *Chief*

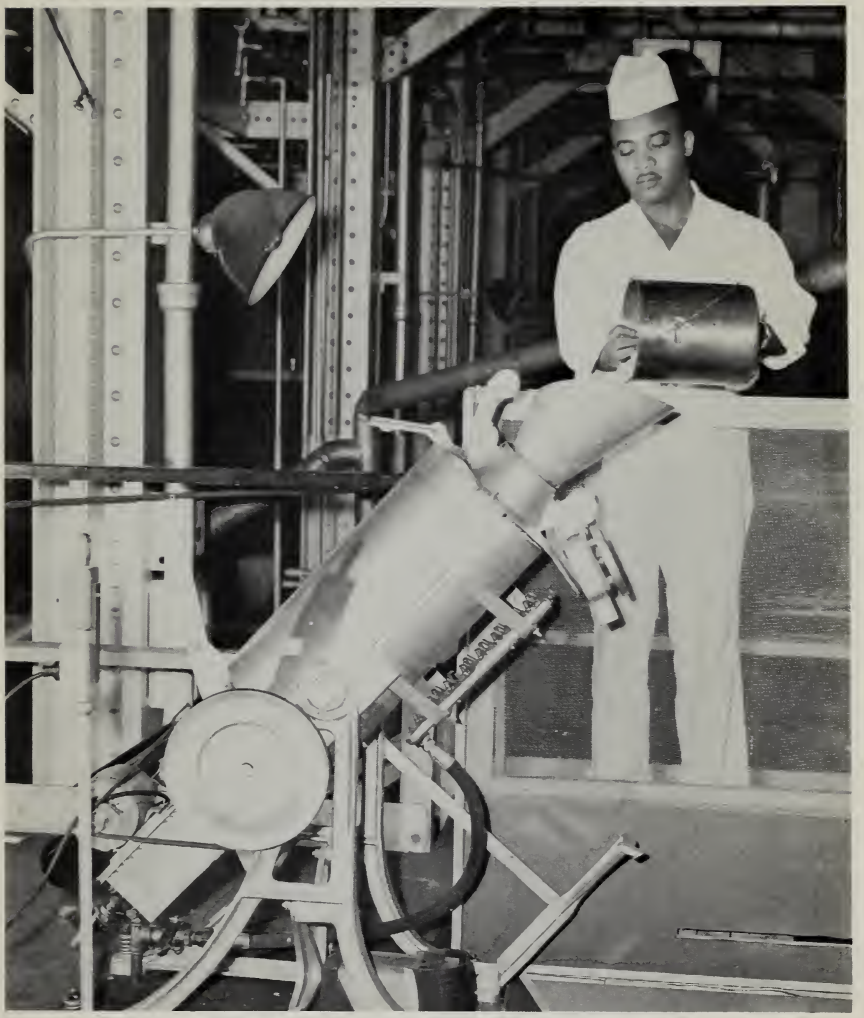
A product or process originating in small-scale research usually requires a great deal of further development before it is ready for commercialization. Will it work on a larger scale? How much will it cost? To answer the first question requires research on a pilot-plant scale employing equipment and methods that can be extrapolated to commercial scale. To answer the second requires the selection of an appropriate area for the hypothetical plant, a profitable scale of operation, and determination of the requirements for buildings, power, raw materials, labor, equipment, packaging, management, and the multitude of other considerations entering into a commercial enterprise.

Since there is often no laboratory counterpart of a new process, this Laboratory originates new processes and products as well as evaluating in the pilot plant processes originating in other Laboratories of the Eastern Division. It also conducts basic engineering research on unit operations common to many processes.

Among processes originating through the research of this Laboratory and already adopted commercially are those for potato flakes (see page 23), recovery and use of concentrated fruit aromas (see page 25), recovery and use of tomato cannery wastes, and preparation of flour and feed from surplus potatoes.

Currently, engineers of this Laboratory are engaged in the development of a vacuum process for drying whole milk. An excellent dry whole milk has been produced by a continuous process. Improvements in the keeping properties of dry whole milk are also being sought so that the product can be stored on the shelf for six months without loss of its beverage quality.

Also under development at this Laboratory is a method of dehydrating fruit and vegetable pieces so that they will reconstitute when cooked in water for five or six minutes. Called explosive puffing, the process involves heating the partially dried pieces in a closed container until the required amount of pressure is built up, and then suddenly releasing them to the atmosphere. This explosion creates tiny channels in the pieces through which the remaining water can be readily removed when the pieces are returned



Partially dehydrated fruit and vegetable pieces are loaded into gun for explosive puffing.

to the drier for final dehydration. The pieces can be quickly reconstituted because of the speed with which the water re-enters them through these same channels. The process has been applied successfully in the pilot plant to potatoes, carrots, beets, sweetpotatoes, apples, blueberries, and other vegetables and fruits. Tests on a commercial scale are now in process.

PIONEERING RESEARCH LABORATORIES

Much of the fundamental research for which the U. S. Department of Agriculture has been famous for many years has been carried on since 1957 in Pioneering Research Laboratories. These Laboratories consist of small groups of exceptional scientists working under the direction of a renowned leader in his field. Of the 23 Pioneering Research Laboratories in the Department, 2 are located at the Eastern Utilization Research and Development Division.

Animal Proteins

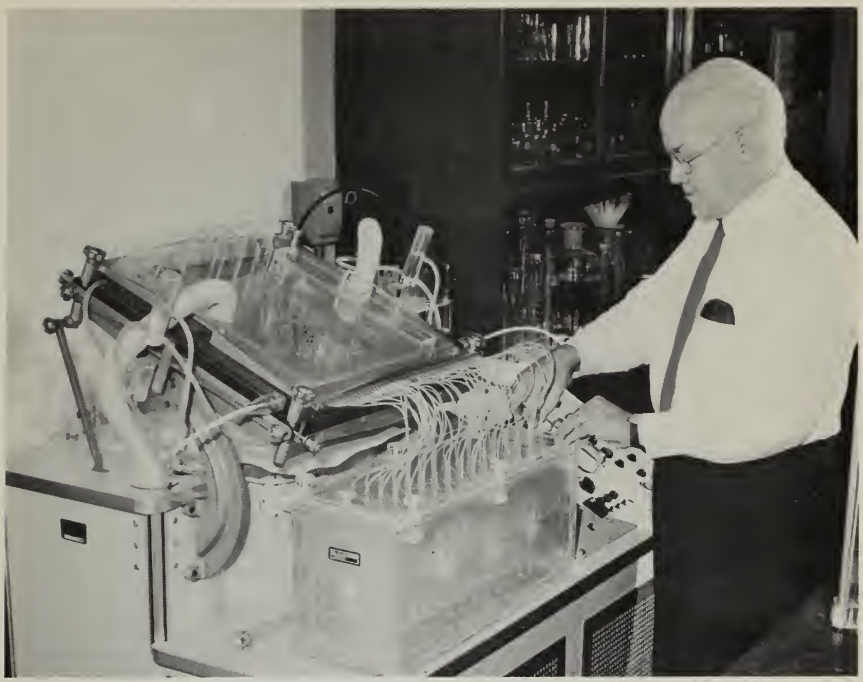
DR. T. L. McMEEKIN
Chief Research Chemist

Scientists of this Laboratory investigate the basic properties of milk proteins. The work includes isolating the proteins, characterizing them, and determining their specific structure. Milk contains a complex mixture of proteins, and the information obtained by painstaking research on the properties of the individual proteins as well as of artificial mixtures will advance scientific knowledge of these substances as well as contribute to the future technology of milk and milk products.

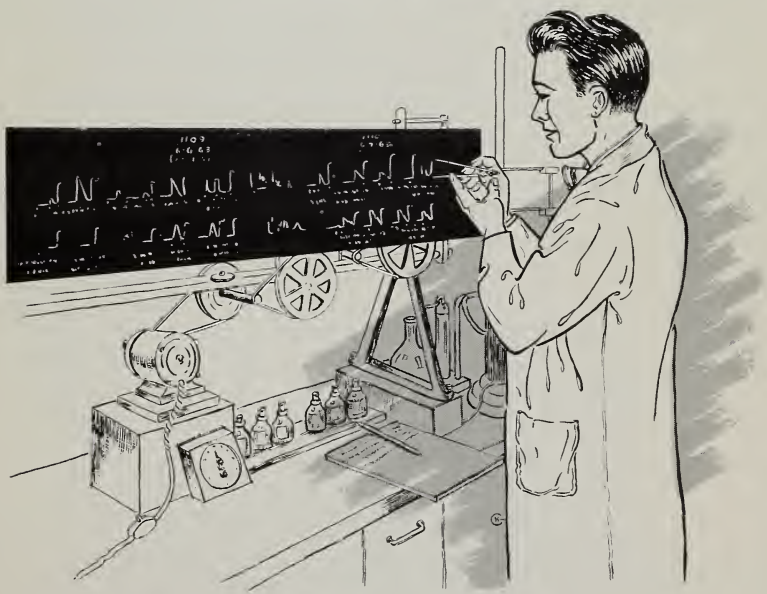
Allergens in Agricultural Products

DR. H. STEVENS
Principal Research Biochemist

This Laboratory also has behind it a long history of research on a subject important for the utilization of farm commodities. Such products as castorbeans, cottonseed, and milk contain substances called allergens which can cause severe reactions in people who are allergic to them. This is a limitation to a wider use of such commodities. Scientists of the Laboratory are making fundamental chemical and immunological studies in an effort to isolate, identify, and if possible, eliminate specific allergens. This work is revealing the physiological nature and mechanisms of allergic sensitivity and its relation to the chemical structure of allergens.



Continuous flow electrophoretic apparatus is used to separate milk proteins.



Reaction of sensitized animal muscle tissue to an allergen is recorded on the smoked screen of a kymograph.

ACCOMPLISHMENTS

As an indication of the benefit being received from the research conducted at the Eastern Division, there follows a brief description of a few of its most outstanding accomplishments. Included are some of the most successful commercialized developments, as well as a few achievements in basic research for which Eastern Division scientists have become known widely throughout the scientific community.

Plastics and Detergents from Fats

Plastics and detergents have become household words during the past generation. This has been largely as a result of research by the petrochemical industry and has been at the expense of products made from agricultural commodities.

When detergents replaced soap, they deprived animal fats of their primary market. The Eastern Division created a new market for some of the surpluses that resulted by sponsoring research that established the advantages of adding fats to poultry and other livestock feeds. About 500,000,000 pounds of fats now go into feeds annually.

Other studies have sought to exploit the vast possibilities for fats in the plastics field. Excellent plasticizers known as epoxides have been developed from fats which impart remarkable resistance to deterioration of plastics by heat and light. Since their introduction a few years ago, their commercial production has increased to about 50 million pounds a year.

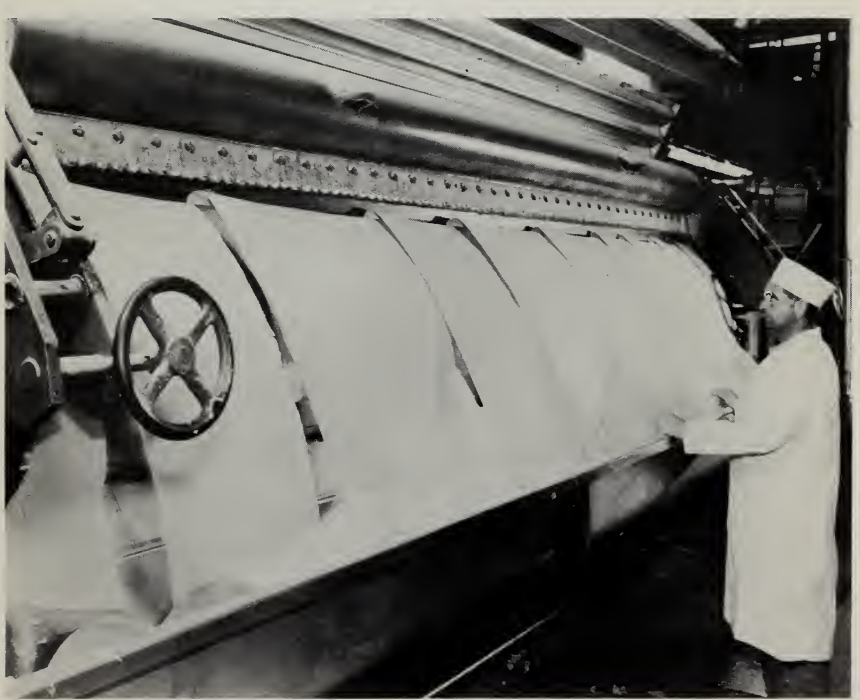
Eastern Division research has shown that detergents can be made from animal fats as well as from petroleum. Some excellent detergents have been produced by the sulfonation of fatty acids. Although they have been commercialized, they have not been widely used because they are more expensive than petroleum-based detergents, most of which are made from alkylbenzenesulfonate (ABS). Recently, serious objections have been raised to these ABS detergents because they are not readily digested by the microorganisms used in sewage treatment, and hence they cause foaming in streams. Since fats are straight-chain compounds, detergents made from them should be more biodegradable than the branched-chain ABS detergents. As the demand for biodegradability increases, this advantage may become of great importance.

Potato Flakes

Today's supermarket shelves contain several brands of a phenomenally successful dehydrated mash-potato product called potato flakes. They are made by drying mashed potatoes on the surface of a revolving drum. In this completely novel process, devised by Eastern Division engineers, the potatoes are dried so rapidly that their flavor and texture are preserved.

By 1963, five years after commercialization of the product, potato flakes were being made in 10 plants in the United States and in other plants throughout the world. American production for the year was estimated to be 47 million pounds, worth 30 million dollars at retail. This represents over 6 million bushels of potatoes that might otherwise have been surplus.

By the Eastern Division process, excellent potato flakes can be made from a wide variety of potatoes, not only from the high-solids Idaho-type previously considered the only ones suitable for dehydration. Potato-flake



Sheets of dehydrated mashed potato coming from commercial drum dryer ready to be broken into potato flakes.

plants are now in operation in most of the principal potato-growing States, including Maine, New York, Minnesota, North Dakota, Idaho, and Oregon.

Consumers have enthusiastically received potato flakes, since they combine the convenience of a processed food with the wholesome flavor of a freshly prepared dish. Such dehydrated potato products as potato flakes and potato granules—granules have been greatly improved by research at the Western Utilization Research and Development Division—are credited with the recent reversal in a 50-year trend toward lower consumption of potatoes. A vigorous potato-processing industry can save growers from economic loss in times of surplus by providing a market for their excess production.

Foam-Spray-Dried Dairy Products

Foam-spray drying, a new process for making dehydrated dairy products, has been applied successfully to nonfat milk and cheese whey and is under experimentation for whole milk. The method consists essentially of injecting a gas into a concentrate to form a finely dispersed mixture which is then sprayed into a drying chamber as relatively large particles of foamy or puffed material. Drying is rapid because the foamy particles have a relatively large surface exposed to the drying air.

Cottage cheese whey, difficult to dry by conventional procedures because of its high acid content, can be readily dried by this process. A valuable food and feed additive, the whey powder includes milk sugar, protein, calcium and other milk salts, and fairly large amounts of riboflavin and other B vitamins.

Foam-spray drying introduces new economy in the production of dehydrated nonfat milk. One reason is that the process will dry liquids of higher solids content than conventional spray-drying methods. With more water removed in the evaporator, powder production is faster. Also, with foam-spray drying, quick dispersibility of the particles in water during reconstitution can be achieved without the "instantizing" step necessary with conventional spray drying.

Fruit Flavors Captured

Juice concentrates made from apples, grapes, and other fruits by a process that recovers their volatile aroma or flavor are now becoming commercialized. The essence-recovery process by which these concentrates are made is one of the most important engineering achievements of the Eastern Division.

When a fruit juice is evaporated, most of its flavor normally escapes along with the water. The recovery process permits this flavor to be captured as a concentrated "essence," with 100 to 1000 times the flavor strength of the original juice.

These fruit essences are now used commercially in the making of jellies and can be used in the flavoring of such food products as ice cream, candy, and carbonated beverages. More important, the essence-recovery process has provided the key to the production of apple and grape concentrates, such as those now becoming commercially available. These concentrates are made by removing the essence and concentrating the juice, then adding back the concentrated essence to restore the initial flavor and aroma. The process can also be extended one more step to remove virtually all the water, making dried juice powders. These represent the ultimate in shipping and storing economy and will keep for long periods at normal temperatures.

Glutaraldehyde Leather

A new kind of leather that resists deterioration by perspiration, has a pleasing softness, and can be dyed uniformly is now being produced commercially. The leather is made by tanning hides and skins with a chemical known as glutaraldehyde using a process developed by Eastern Division chemists. Good leather can be made by this process over a wide range of tanning conditions.

Shoe uppers, gloves, jackets, and other garments made of glutaraldehyde leather take advantage of the material's inherent resistance to perspiration and other acids. Since the tannage also withstands the deteriorating effects of hot soap solutions, it may ultimately lead to the production of washable garment leathers.

This economical process is so attractive to tanners, and products made from this leather are so appealing to consumers, that an estimated 20 million square feet of hides and skins worth about 10 million dollars were tanned with glutaraldehyde in 1962.

New processes such as this are helping agriculture to hold its markets for leather in the face of increasing competition from synthetic materials.

Revolution in Maple

The maple groves of Vermont, New York Wisconsin, and many other States are witnessing a renaissance in an industry as old as America itself. Modernization of maple-sirup processing, which has been spearheaded by scientists of the Eastern Division, has virtually revolutionized the industry.

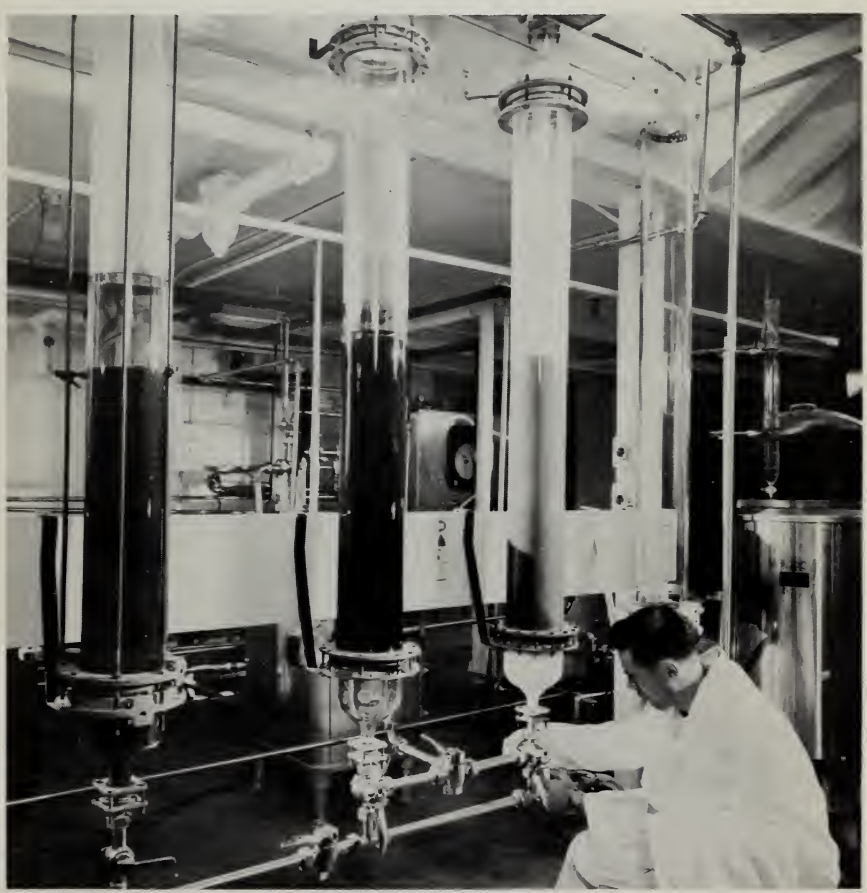
Our scientists have taught producers sanitary methods of collecting sap to avoid quality-degrading contamination by microorganisms. New equipment and methods have streamlined the sirup-making operation and reduced it from an art to an exact science.

Modern sirup producers use miles of plastic tubing to conduct the sap from the trees to central collection points. They use formaldehyde pellets in the taphole to prevent premature stoppage and deterioration of quality by the growth of microorganisms. They use the most advanced and sanitary methods of converting sap to sirup. Such developments and many more have been pioneered by the research on maple of the Eastern Division.

As a result of this work there is a new trend in maple production known as central evaporation. Throughout the maple-producing areas of the country central evaporator plants are being established where year-round employment is provided in processing the sap collected from many surrounding farms into sirup and other maple products.

Removal of Radiostrontium from Milk

One significant development of the Eastern Division is unique in that a need did not exist for it at the time it was being worked on, no need for it exists now, and there is universal hope that it will never be needed. This is a standby process developed at the Beltsville, Maryland, pilot plant of the Dairy Products Laboratory for the removal of strontium 90 from milk which may become contaminated by nuclear fallout.



Radiostrontium being removed from milk on pilot-plant scale at Beltsville, Md., laboratory.

In this ion-exchange process, slightly acidified milk is filtered through columns of resin that have been charged with mineral salts similar in composition to salts found in the milk. Radiostrontium ions change place with mineral salts in the resin. The milk, freed of most of the radiostrontium, has its excess acidity neutralized, and is then pasteurized and homogenized as usual.

The process, which was developed jointly by the U. S. Department of Agriculture, the Department of Health, Education and Welfare, and the Atomic Energy Commission, is now being evaluated on a commercial scale under the terms of a contract supported jointly by USDA and HEW. Pilot-plant operations have demonstrated that more than 90 percent of radioactive strontium can be removed from milk by this process.

Genetic Varients of Casein

The outstanding research done by Eastern Division scientists in the separation and characterization of milk proteins has earned them many coveted awards and a worldwide reputation. When it was discovered that casein, which accounts for about 90 percent of the proteins in milk, was not a single component but a mixture of at least three substances, methods for their separation were worked out by these chemists. The components were called alpha-, beta-, and gamma-casein.

Since then, protein chemists have discovered much more about the complexity of casein. For example, part of alpha-casein is not soluble in calcium chloride. This part, called $alpha_s$-casein, has been analyzed by Eastern Division scientists using very sensitive paper and gel electrophoresis techniques. The work showed that all $alpha_s$-caseins, obtained from the milk of individual cows, are not alike.

These differences have now been traced to a genetic source by painstaking research undertaken with the cooperation of USDA geneticists at Beltsville, Md., and involving many hundreds of samples obtained from cows of known ancestry. This finding may be of considerable importance to fundamental research in genetics.

Ironweed Seed Oil

Epoxy fatty acids, now made synthetically for use in plastics, paints, and other industrial products, can be obtained from the seed of the ironweed plant (*Vernonia anthelmintica*). This finding was made as a result of the Agricultural Research Service's research program on new crops in which foreign plants are analyzed for components that may make them valuable industrially and suitable as replacement crops for those now in surplus.

The industrial value of this oil is now being established as agronomic studies are being undertaken to determine whether the ironweed would be a satisfactory crop for farmers to grow as a source of this oil.

Meat Flavors

Research to establish the specific chemical components responsible for the flavor of meat has established that the distinctive differences in taste between beef, pork, and lamb, are in the fat portions of these meats, and not in the lean. When all the fat is removed, and water extracts of the flavor-producing substances of the lean portions are freeze-dried to a powder and heated, essentially the same meaty aroma is produced whether the sample is beef, pork, or lamb.

Different kinds of meat can be distinguished from each other only when the fats are present. Carbonyls are suspected of being at least partially responsible for the mutton flavor in lamb.

Bacteriophage Control

Bacteriophage is a virus that destroys bacteria, or limits their vigorous, abundant growth. It is a constant threat to the cheesemaker because, if it contaminates starter cultures, it prevents them from developing the acidity required to make cheese.

Research by Eastern Division scientists has shown cheesemakers how economic loss through the spread of bacteriophage can be eliminated by adding phosphate to the starter cultures and heating to bind the calcium.

Stock solutions of these phosphates are available commercially. Specific directions for their use in preventing bacteriophage can be obtained from the Eastern Division.

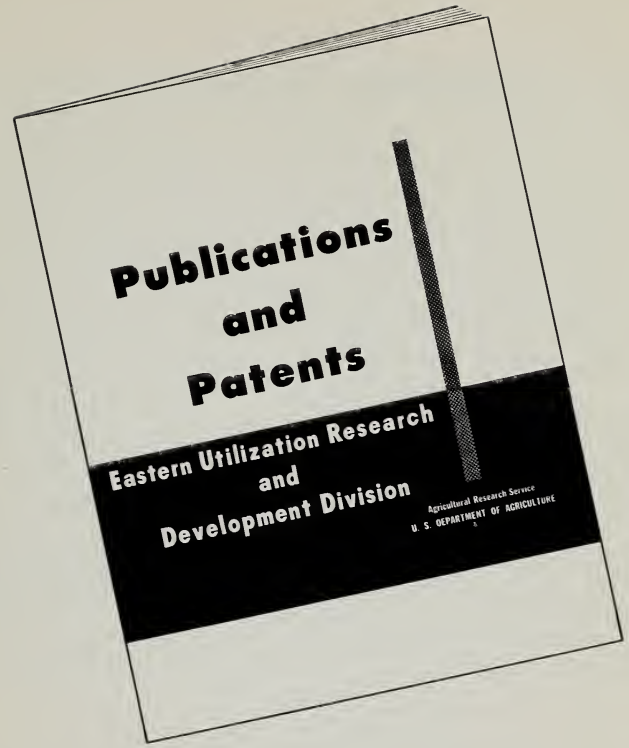
Mechanical Harvesting of Cherries

Fundamental research by Eastern Division chemists on the red tart cherry has culminated in a completely new method of harvesting that is revolutionizing the cherry processing industry. The research was to discover the reason for a defect in canned and frozen cherries known as scald—an unsightly discoloration of the cherry surface.

Chemical analyses and microscopical studies traced scald to bruising. When it was found that most bruising occurred during harvesting, methods were sought that would do less damage to the cherries than hand picking. Studies showed that one way of significantly reducing bruising was to shake the cherries from the tree into a collecting net.

Eastern Division chemists worked with agricultural engineers and horticulturalists of the Michigan Agricultural Experiment Station and with farm equipment manufacturers to develop mechanical tree shakers. Over a thousand tons of red tart cherries were harvested with these machines in both the 1962 and 1963 seasons. Although some adjustments were required at the processing plant to accommodate them, these cherries were considered equivalent to hand-picked fruit in processing quality.

Mechanical harvesting costs only half as much as hand picking. Since a 5-man crew can pick as many cherries in a day as 80 hand laborers, mechanical harvesting may prove to be vital to the very existence of the cherry industry as labor costs rise and the difficulties of getting and keeping hand pickers increase.



Since 1940 Eastern Division scientists have prepared almost 2,000 publications, and their developments are covered by over 350 patents. The publications are mostly technical articles in scientific journals and books, but they also include a number of USDA Bulletins and Handbooks and some semi-popular reviews of the work in progress.

The patents are awarded for inventions resulting from the work, and are assigned by the inventor to the Secretary of Agriculture. Any individual or organization in the United States can obtain cost-free licenses to use these patented inventions. Patents that have been issued or are pending cover such diverse subjecs as polymers, stabilizers, and detergents from animal fats; improved maple products; food-dehydration processes such as foam-spray and vacuum drying for whole milk, drum drying of potato flakes, and explosive puffing for quick-cooking fruit and vegetable pieces; and various leather tanning processes.

A list of the publication and patents of the Eastern Utilization Research and Development Division, issued semiannually, is available on request.

VISITORS WELCOME

Visitors are always welcome at all the Laboratories of the Eastern Division. Those with special interests can arrange conferences with staff members to discuss their research work. Groups will be given conducted tours. Arrangements for visits should be made with the Director or members of the staff. Children over 12 may be included in the tours. All Laboratories are open daily except Saturdays, Sundays, and holidays.

Location and Transportation

EASTERN UTILIZATION RESEARCH AND DEVELOPMENT DIVISION

Headquarters:

600 E. Mermaid Lane
Philadelphia, Pa. 19118

Open 8:30 a. m. to 5:00 p. m. Telephone 215 CH 7-5800

Washington Laboratories:

U. S. Department of Agriculture South Building
14th Street and Independence Avenue, S.W.
Washington, D. C. 20250
Dairy Products Laboratory—Room 1655
Allergens Pioneering Research Laboratory—Room 0125

Open 9:00 a. m. to 5:30 p.m. Telephone 202 RE 7-4142

Beltsville Laboratories:

Agricultural Research Center
Beltsville, Md. 20705
Meat Laboratory—Building 157
Dairy Products Laboratory—Building 200*

Open 8:00 a. m. to 4:30 p. m. Telephone 301 GR 4-4800

*Radioisotope Removal and Cheese Investigations

Student visitors from area engineering college arriving for tour of laboratories.

Briefing session preceding tour of laboratories.

How to Reach the Wyndmoor Laboratories

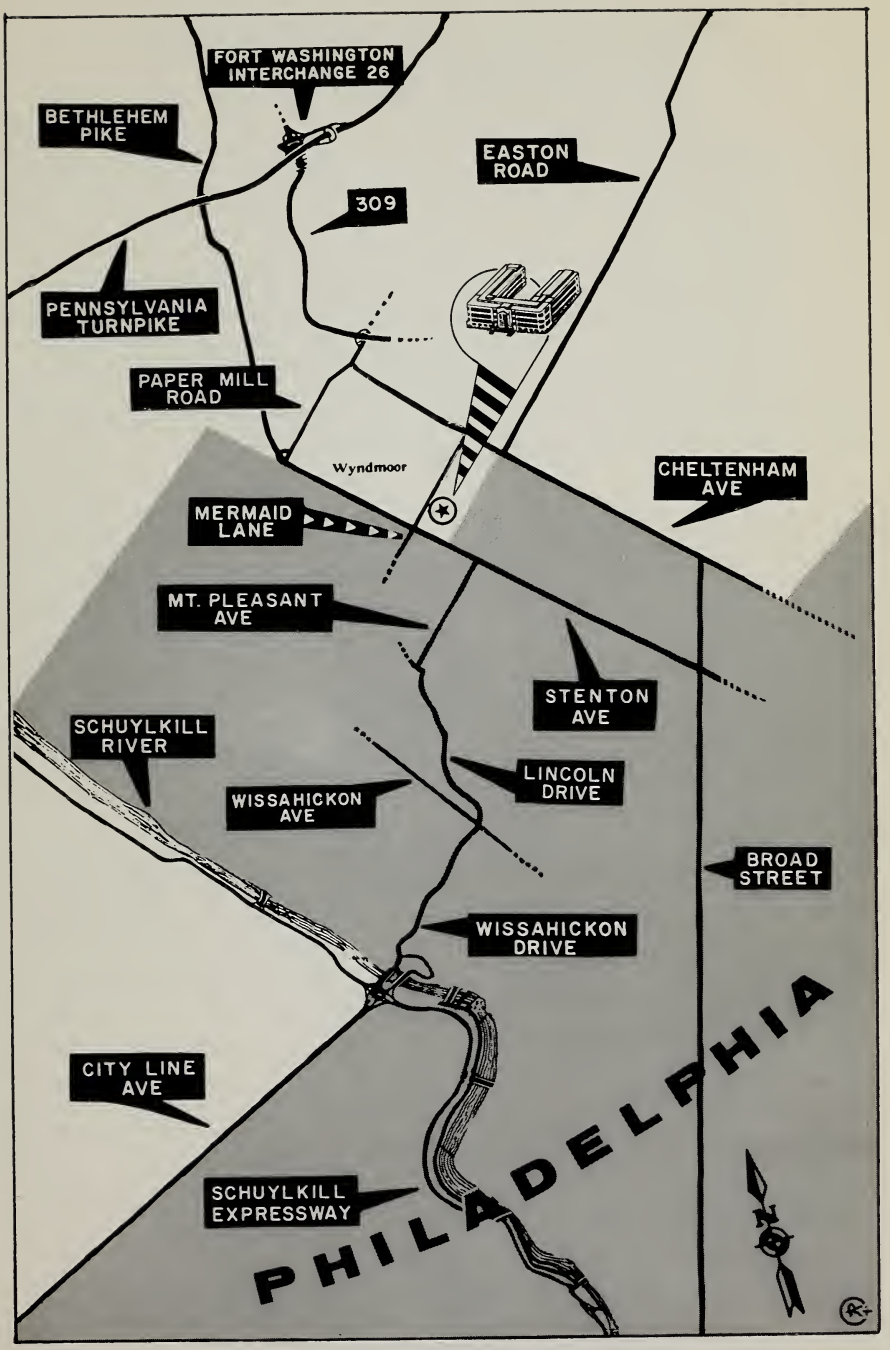
By car. From the north, east, and west, the point most accessible by car to the Wyndmoor Laboratories is the Fort Washington Interchange of the Pennsylvania Turnpike. From here, follow U. S. 309 south to the Paper Mill Road exit (2.4 mi.). Turn right to Cheltenham Avenue (0.3 mi.), then left to Mermaid Lane (1.2 mi.), then right. Laboratories are on the left side of Mermaid Lane 0.9 mi. from Cheltenham Avenue.

From the south, approach Philadelphia on U. S. 1 (City Line Avenue) or use Schuylkill Expressway (Pa. 43) from the center of Philadelphia. The expressway connects with U. S. 1 at an exit marked "City Avenue Bridge, Germantown, Chestnut Hill" (5.2 mi. north of Market Street). Cross bridge over Schuylkill River and follow signs to Wissahickon Drive. Proceed to Wissahickon Avenue, which crosses Wissahickon Drive 2.6 mi. from the expressway. Continue on the drive (known as Lincoln Drive north of Wissahickon Avenue) for 2.2 mi. to Mt. Pleasant Avenue. Turn right to Stenton Avenue (1.3 mi.), then left to Mermaid Lane (0.9 mi.) Laboratories are on the right side of Mermaid Lane, 0.2 mi. from Stenton Avenue.

By Pennsylvania Railroad. Take Chestnut Hill train from Philadelphia at Suburban Station, 16th Street and Kennedy Boulevard; at 30th Street Station; or at North Philadelphia Station. Laboratories are 1½ mi. from Chestnut Hill Station. Take a taxi or a southbound "L" bus marked "Broad-Olney Subway" to Stenton Avenue and Mermaid Lane and walk 2 blocks to the Laboratories.

By Reading Railroad. Take Chestnut Hill Train from Philadelphia at Reading Terminal, 12th and Market Streets; at North Broad Street Station; or at Wayne Junction. Get off at Wyndmoor. Laboratories are 5 blocks from station on Mermaid Lane.

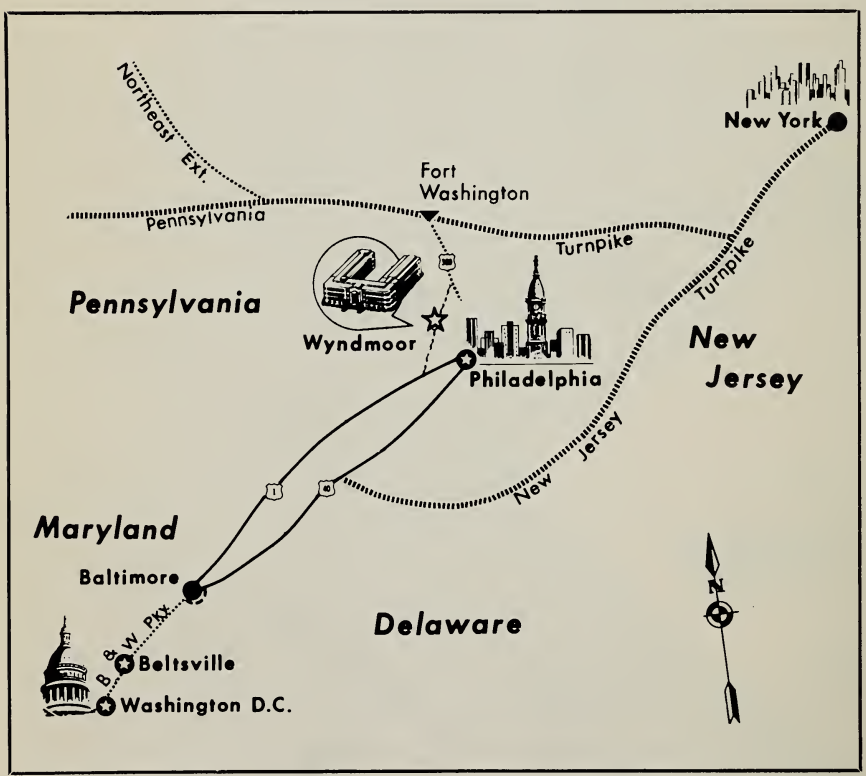
By local transportation. Take a Broad Street Subway train to Olney Avenue. Get transfer when paying fare. Transfer to "L" bus marked "Erdenheim" at northwest corner of Broad Street and Olney Avenue. Get off bus at Mermaid Lane and Stenton Avenue, and walk 2 blocks to the Laboratories.


FORT WASHINGTON INTERCHANGE 26
BETHLEHEM PIKE
EASTON ROAD
309
PENNSYLVANIA TURNPIKE
PAPER MILL ROAD
Wyndmoor
CHELTENHAM AVE
MERMAID LANE
MT. PLEASANT AVE
STENTON AVE
SCHUYLKILL RIVER
LINCOLN DRIVE
WISSAHICKON AVE
BROAD STREET
WISSAHICKON DRIVE
CITY LINE AVE
SCHUYLKILL EXPRESSWAY
PHILADELPHIA

How to Reach the Washington and Beltsville Laboratories

The Washington Laboratories are located in the U. S. Department of Agriculture's South Building, near the Washington Monument and Smithsonian Institution.

The Beltsville Laboratories are located at the Agricultural Research Center, which lies between U. S. 1 and the Baltimore-Washington Parkway, about 15 miles northeast of Washington. The Laboratories are reached conveniently only by automobile. The Beltsville stop of the Greyhound and National Trailways buses, which run on U. S. 1 between Washington and Baltimore, is about 2 miles from the Laboratories.



General Information on the

NUTRITION, CONSUMER, AND INDUSTRIAL UTILIZATION RESEARCH DIVISIONS

Agricultural Research Service, U. S. Department of Agriculture

Division	*Director*	*Mailing Address*	*Fields of Research*
Eastern Utilization Research & Development	Dr. P. A. Wells	600 E. Mermaid Lane, Philadelphia, Penna. 19118	Animal products: dairy, meat, fats, and leather; plant products: Eastern fruits and vegetables, tobacco, honey, maple, and new crops; allergen studies.
Northern Utilization Research & Development	Dr. F. R. Senti	1815 N. University St., Peoria, Ill. 61604	Cereal grains: corn, wheat, barley, grain sorghum, and oats; oilseeds: soybean, flaxseed, safflower, and erucic acid-containing oilseeds; new crops.
Southern Utilization Research & Development	Dr. C. H. Fisher	1100 Robt. E. Lee Blvd., New Orleans, La. 70119	Cotton and cottonseed; tung fruit; pine gum; Southern fruits and vegetables, including citrus, sweet potatoes, and cucumbers; sugar cane; rice; peanuts; new crops.
Western Utilization Research & Development	Dr. M. J. Copley	800 Buchanan St. Albany, Calif. 94710	Western fruits, nuts, vegetables, and rice; poultry products; forage crops; wheat; barley; wool and mohair; sugar beets; dry beans and peas; castor beans; new crops.
Clothing & Housing Research	Dr. Esther L. Batchelder	Agricultural Research Center, Beltsville, Md. 20705	Consumers' needs for clothing and housing; performance and household use of fabrics and equipment; functional design to solve special problems.
Consumer & Food Economics Research	Dr. Faith Clark	Federal Center Building Hyattsville, Md. 20781	Levels of living as determined by surveys; nutritional appraisal of diets and food supplies; problems of household management.
Human Nutrition Research	Dr. C. Edith Weir (Acting)	Agricultural Research Center, Beltsville, Md. 20705	Metabolic processes and nutritional requirements of man; nutritive and other consumer values of food.

WYNDMOOR, PA.

Washington, D.C. Beltsville, Md.